FECAL COLIFORM
TOTAL MAXIMUM DAILY LOADS (TMDLs)

in the

Lake Okeechobee Basin

Mosquito Creek and Henry Creek

Okeechobee County, Florida

Prepared by:

US EPA Region 4
61 Forsyth Street SW
Atlanta, Georgia 30303

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LIST OF ABBREVIATIONS

BMP	Best Management Practice
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
HUC	Hydrologic Unit Code
LA	Load Allocation
ML	Milliliter
MF	Membrane Filter
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
SFWMD	South Florida Water Management District
TMDL	Total Maximum Daily Load
WBID	Water Body Identification
WLA	Waste Load Allocation
WQS	Water Quality Standard

SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   County: Okeechobee
   Major River Basin: Taylor Creek Basin (HUC 03090201)

   Impaired Waterbodies (1998 303(d) List):

WBID	Segment Name	Constituent(s)
3203B	Mosquito Creek	Fecal Coliform
3213B	Henry Creek	Fecal Coliform

2. **TMDL Endpoints (i.e., Targets)**
   Fecal Coliform: 400 counts/100 ml.

3. **Coliform Allocation (counts/day):**

Waterbody	WLA	LA	MOS	TMDL
Mosquito Creek (WBID 3203B)	0	54 % reduction	Implicit	54% reduction
Henry Creek (WBID 3213B)	0	68% reduction	Implicit	68% reduction

4. **Public Notice Date:** September 30, 2003

5. **TMDL Considers Point Source, Nonpoint Source, or both**: Nonpoint Source Only

6. **Major NPDES Discharges to surface waters:** None

FECAL COLIFORM TOTAL MAXIMUM DAILY LOAD (TMDL)
MOSQUITO CREEK (WBID 3203B) and HENRY CREEK (3213B)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology-based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (EPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into five groups. Water quality is assessed in each group on a rotating five-year cycle. Mosquito Creek and Henry Creek are in the Lake Okeechobee Basin, a Group 1 Basin, first assessed in 2000 with plans to revisit water management issues in 2005 (Figure 1). FDEP established five water management districts responsible for managing groundwater and surface water. The Lake Okeechobee Basin is in the South Florida Water Management District (SFWMD).

For the purpose of planning and management, basins are divided into planning units. A planning unit is either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. These planning units contain smaller, hydrological units called drainage basins, which are further divided into water segments. A water segment usually contains only one unique waterbody type (stream, lake, canal, etc.) and is about five square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment.

2.0 PROBLEM DEFINITION

Waters in Mosquito Creek (WBID 3203B) and Henry Creek (WBID 3213B) are designated as Class III waters having a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Florida's final Clean Water Act 1998 Section 303(d) list identified WBIDs in the Lake Okeechobee

Basin that do not support water quality standards (WQS). Mosquito Creek (WBID 3203B) and Henry Creek (WBID 3213B) were identified as being impaired for coliform bacteria. EPA is responsible for developing the fecal coliform bacteria TMDLs for these two water bodies (Table 1).

Table 1. TDMLs Developed By EPA in the Lake Okeechobee Basin

WBID	Name	Planning Unit	Parameter of Concern
3203B	Mosquito Creek	NHLMS Complex	Fecal Coliform
3213B	Henry Creek	NHLMS Complex	Fecal Coliform

The TMDLs addressed in this document are being established pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

The format of the remainder of this report is as follows: Chapter 3 is a general description of the Mosquito Creek and Henry Creek watershed; Chapter 4 describes the water quality standard and target criteria for the TMDLs; Chapter 5 describes the development of the coliform TMDLs including a section detailing the data assessment, source assessment, TMDL development and margin of safety.

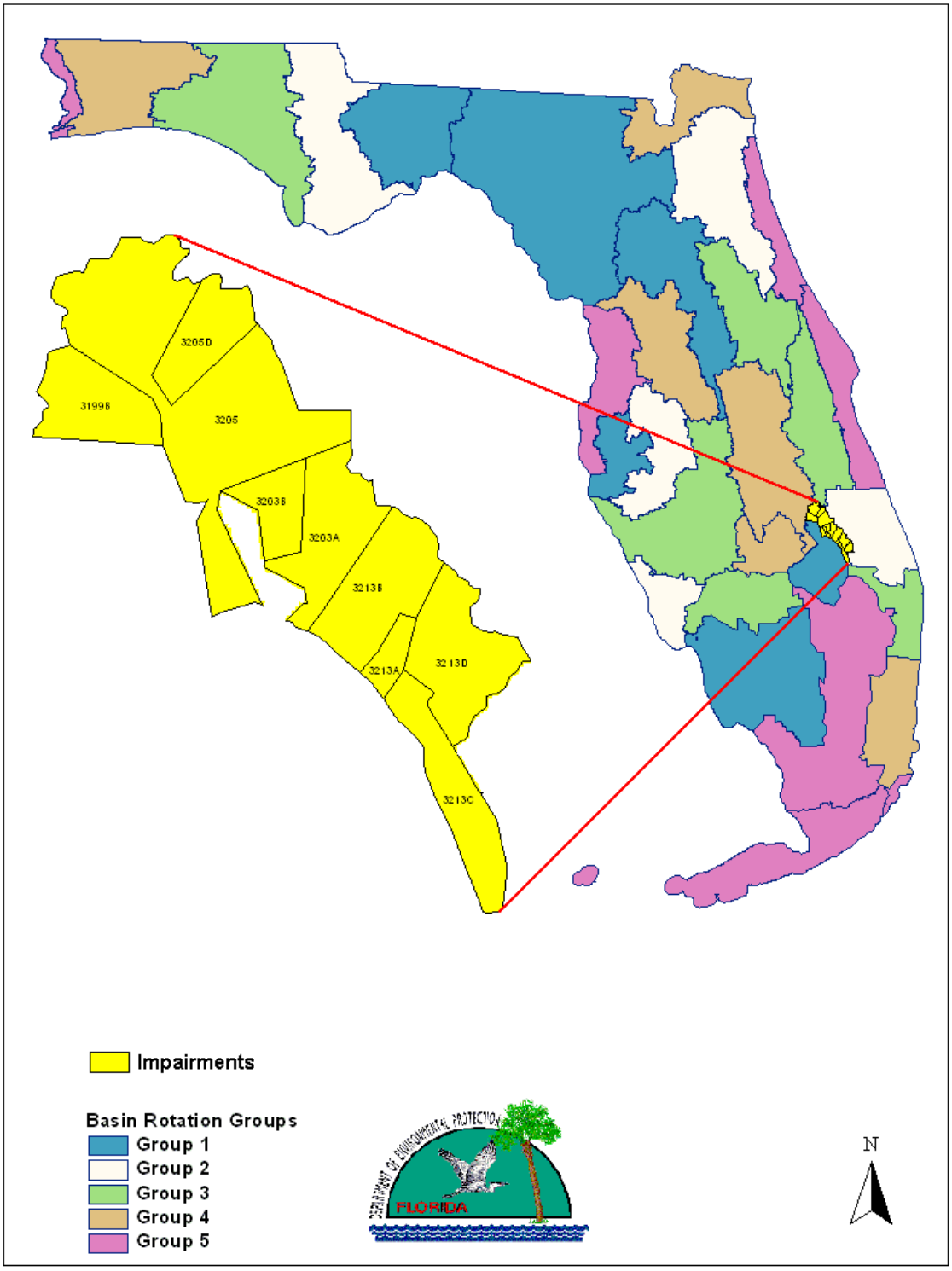

Figure 1. Impaired WBIDs located in the Lake Okeechobee Basin.

3.0 WATERSHED DESCRIPTION

One of the planning units in the Lake Okeechobee Basin is the NHLMS Complex (Nubbin Slough, Henry Creek, Lettuce Creek, Mosquito Creek, Myrtle Slough, and waters within the drainages leading to the South Florida Water Management District's structures S-135 and S-153). The NHLMS Complex covers about 131 square miles and contains about 29 miles of streams. It consists of a collection of small tributary streams along the northeast shore of Lake Okeechobee that once flowed directly into the lake but are now intercepted by canals prior to reaching the Hoover Dike/Levee. Mosquito Creek (WBID 3203B) is four miles long and flows from northeast to southwest where it is intercepted by the L-63 canal, which transports water to the rim canal (C-59), and the S-191 structure which discharges to the lake. Land uses include dairies, pasture, and citrus production (Table 2). Henry Creek (WBID 3213B) is four miles long and flows from northeast to southwest where it is meets the rim canal (C-59) and flows into the lake via Gate 36 (Henry Creek Lock) and the S-135 structure six miles to the southeast. Land uses include dairies, pasture, and low-density residential housing (FDEP, 2001).

Table 2. Land Use Distribution (source: Vogelmann, et al., 2001)

Waterbody	Urban		Commercial, industrial, transportation		Agriculture		Rangeland		Forest		Water		Wetlands		Barren & transitional		Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres
Mosquito Creek (WBID 3203B)	54	0.9	91	1.5	3233	51.6	1415	22.6	225	3.6	84	1.3	1163	18.6	2	0.0	6267
Henry Creek (WBID 3213B)	13	0.0	49	0.0	5065	33.4	4614	30.5	915	6.0	186	1.2	4283	28.3	18	0.3	15142

4.0 WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Tributaries in the Lake Okeechobee Basin are classified as Class III waters, with a designated use classification for recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters, are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative or more stringent criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time.

Fecal coliform bacteria are a subset of the total coliform group and indicate the presence of fecal material from warm-blooded animals. Total coliform bacteria generally indicate the presence of soil-associated bacteria and result from natural influences on a water body such as rainfall runoff as well as sewage inflows. There are no total coliform data for these two waterbodies. Florida's Class III water quality criteria for fecal coliform bacteria is as follows:

> The most probable number (MPN) or membrane filter (MF) counts per 100 ml shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. (Section 62-302.530(6) F.A.C.)

To ensure protection of all conditions, the target used for the fecal coliform TMDL is the more stringent criterion of 400 counts per 100 ml. All data are considered in the TMDL rather than allowing 10 percent of the samples to exceed 400 counts per 100 ml. Since less than 10 samples were collected in a 30-day period it is not possible to determine violations of the 30-day 200 count geometric mean. Furthermore, based on the source assessment, continuous discharges of coliforms do not exist in the watershed. Only storm water sources contribute coliforms to the watershed and therefore the 30-day average is assumed to be protected if the storm event concentrations are met according to this TMDL.

5.0 DEVELOPMENT OF COLIFORM TMDLS

5.1 Water Quality Assessment and Deviation from Target

Fecal coliform data are collected at two monitoring stations on Mosquito Creek. Table 3 is a list of the data used in the water quality assessment and TMDL development. Less than 10 samples were collected in Mosquito Creek during the last five years; therefore, the evaluation period includes all data collected since 1989. Over the evaluation period,

one sample exceeded the one-day maximum criterion of 800 counts per 100 ml and four of the 12 samples, or 33 percent, exceeded the 400 counts per 100 ml criterion which is not to be exceeded in more than 10 percent of the samples. Insufficient data are available to evaluate the 30-day geometric mean criterion.

Table 3. Fecal Coliform Monitoring Data Collected in Mosquito Creek (WBID 3203B)

Station Name	Date	Measured Concentration (counts/100ml)
21FLA 26010408	1/4/89	870
21FLA 26010408	4/11/89	660
21FLA 26010408	7/19/89	280
21FLA 26010408	8/11/94	90
21FLA 26010408	4/12/95	120
21FLA 26010408	5/18/99	30
21FLA 26010408	9/5/01	730
21FLA 26010408	11/18/01	250
21FLA 26010408	12/4/01	470
21FLWPB 26010467	9/5/01	110
21FLWPB 26010467	11/18/01	80
421FLWPB 26010467	12/3/01	250

On Henry Creek, fecal coliform data are collected at three monitoring stations (Table 4). Of the six samples collected in the stream, the high value of 1250 exceeded the one-day maximum criterion of 800. This also resulted in 17 percent of the samples exceeding 400, higher than the 10 percent allowed. Insufficient samples were collected to evaluate the 30-day geometric mean criterion.

Table 4. Fecal Coliform Monitoring Data Collected in Henry Creek (WBID 3213B)

Station Name	Date	Measured Concentration (counts/100ml)	Data Qualifier (see Note 1)
21FLA 26010402	4/11/89	40	
21FLA 26010402	7/19/89	10	K
21FLA 26010428	8/11/94	1250	
21FLA 28010444	1/4/89	70	
21FLA 28010444	4/11/89	20	K
21FLA 28010444	7/19/89	10	K

Note: 1. The data qualifier "K" means the value is off-scale low. Actual value is not known, but is known to be less than value shown.

With the limited data collected in both Mosquito and Henry creeks, it is not possible to define the source of the violations as wet weather or continuous discharge. To ensure protection of all conditions, the target used for the fecal coliform TMDL is the more

stringent criterion of 400 counts per 100 ml. All data are considered in the TMDL rather than allowing 10 percent of the samples to exceed 400 counts per 100 ml. By including all data, an implicit Margin of Safety (MOS) is incorporated in the TMDL.

5.2 Source Assessment

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliform bacteria in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of coliform.

Non-point sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off as a result of storm events. Typical non-point sources of coliform include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

5.2.1 Point Sources

There are a no NPDES permits for discharges of treated sanitary wastewater to either Mosquito or Henry creeks. Municipal Separate Storm Sewer Systems (MS4s) may also discharge bacteria to waterbodies in response to storm events. Currently, large and medium MS4s serving populations greater than 100,000 people are required to obtain a NPDES storm water permit. In March 2003, small MS4s serving urbanized areas will be required to obtain a permit under the Phase II storm water regulations. An urbanized area is defined as an entity with a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile. Based on the 1990 Census of Urbanized Areas, there are no MS4s located in either the Mosquito or Henry creek watersheds. Any future MS4 area will be prescribed a wasteload allocation (WLA) equivalent to the percent reduction assigned to the TMDLs.

5.2.2 Non-point Sources

5.2.2.1 Wildlife

Wildlife deposit bacteria within their feces onto land surfaces where they can be transported during storm events to nearby streams. The bacteria load from wildlife is assumed background, as the contribution from this source is small relative to the load from urban and agricultural areas. In addition, any strategy employed to control this source would probably have a negligible impact on obtaining water quality standards.

5.2.2.2 Agricultural Activities

Agricultural activities surrounding Lake Okeechobee are the dominant land use in the Okeechobee. Dairies, pastureland, and citrus production are the significant land uses in the Mosquito Creek and Henry Creek watersheds. Runoff from pastureland and cattle in streams has the potential to impact water quality. Okeechobee County is Florida's leading beef cattle county with 118,000 heads and the major milk producing county in Florida with 21 dairies and 36,000 cows (FDEP, 2001). Cattle ranching and dairy farming are generally concentrated on the northern and northwestern side of Lake Okeechobee.

5.2.2.3 Onsite Sewage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), coliform bacteria, pathogens, and other pollutants to both ground water and surface water. The number of onsite systems in use is steadily increasing, despite efforts to install sewage connections in high-density areas close to the lake. Failure rates reported for Okeechobee County (approximately 4.5 percent in 1998) are not particularly high; however these rates are based on the number of repair permits issued (FDEP, 2001).

5.2.2.4 Urban Development

Fecal coliform loading from urban areas is attributable to multiple sources including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based

program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, Florida Administrative Code (F.A.C.). The rule requires Water Management Districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a surface water improvement and management plan, other watershed plan, or rule.

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-40.432 (5)(c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's stormwater programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of non-point source pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing impervious surfaces. Technology-based structural BMPs are used to mitigate the increased stormwater peak discharge rate, volume, and pollutant loading that accompanies urbanization.

5.3 Total Maximum Daily Load Development

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. The TMDLs for Mosquito and Henry creeks are expressed in terms of percent reduction, as flow data are not available in the NHLMS Planning Unit to calculate loads.

The approach for calculating coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, as is the case for fecal coliform in both Mosquito and Henry creeks, the TMDLs are expressed as a percent reduction. The reduction is based on the

highest measured concentration violating the water quality criteria and the target concentration of 400 counts/100 ml. Mathematically, the reduction is expressed as:

Percent Reduction = (existing concentration – target)/existing concentration *100

5.4 Existing Conditions

Existing conditions are based on the in-stream water quality violations. The highest concentration measured in Mosquito Creek of 870 counts/100 ml is used to represent existing conditions. This is a conservative estimate of existing conditions as this measurement was collected in 1989 and current trends indicate coliform levels less than 800 counts/100 ml (see Table 3). The highest concentration measured in Henry Creek was 1250 counts/100 ml in 1994 and is used to represent existing conditions (Table 4).

5.5 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. An implicit MOS is used in the TMDLs as the highest concentration measured in the stream is used to represent existing conditions. In addition, all data are considered rather than allowing a 10 percent exceedence of the 400 count/100 ml water quality criterion.

5.6 Determination of TMDL, Wasteload Allocation and Load Allocation

The TMDL values represent the maximum daily load the streams can assimilate and maintain water quality standards. The TMDLs are based on the criteria requiring the counts per 100 ml shall not exceed a concentration of 400 in 10 percent of the samples, as specified in the Class III WQS. The TMDLs are expressed in terms of percent reduction. The WLA for both Mosquito and Henry creeks is zero as there are no NPDES discharges of fecal coliform bacteria. The LA component is expressed as a percent reduction calculated using all available water quality data. For Mosquito Creek, the LA is calculated as follows:

$$LA = (870 – 400)/870 * 100 = 54\ \%$$

For Henry Creek, the LA is calculated as follows:

$$LA = (1250 – 400)/1250 *100 = 68\%$$

The TMDL is the sum of the WLA, LA and MOS components. In the absence of point sources and an explicit MOS, the TMDL is equivalent to the LA reduction. The TMDL components for Mosquito and Henry creeks are shown in Table 5.

Table 5. Fecal Coliform TMDL Components

Waterbody	WLA	LA	MOS	TMDL
Mosquito Creek (WBID 3203B)	0	54 % reduction	Implicit	54% reduction
Henry Creek (WBID 3213B)	0	68% reduction	Implicit	68% reduction

5.7 Future Efforts

These TMDLs present the first phase of a long-term restoration project to reduce fecal coliform loading to acceptable levels (meeting water quality standards) in Mosquito and Henry creeks. FDEP will evaluate the progress of implementation strategies and refine the TMDLs as necessary in the next phase (next five-year cycle). This will include recommending specific implementation plans for identified problem areas with as yet undefined sources and causes of pollution. The phased approach will assure progress toward water quality standards attainment in the future.

Florida's watershed management approach specifies a five-year cycle for planning and assessment. Each watershed will be examined (or re-examined) on a rotating basis. Generally, in years two and three of the five-year cycle, water quality data are collected in support of water quality assessment (including TMDL development) and planning activities. Therefore, a watershed TMDL is developed one to two years prior to commencement of the next cycle's monitoring period.

Mosquito Creek and Henry Creek have a minimal amount of fecal coliform data (going back to 1989 n=12 and n=6, respectively). There are no total coliform data. Nevertheless, since the existing data indicate that water quality standards are not being met, a TMDL is required. Continued monitoring of the fecal coliform concentration at multiple water quality sampling points in the watersheds is critical in characterizing sources of fecal coliform contamination and documenting future reduction of loading. In the next watershed cycle, monitoring should be expanded to provide water quality information to characterize seasonal trends and refined source identification and delineation. Stream flow should be measured or estimated with the collection of each fecal coliform sample to characterize the dynamics of fecal coliform transport within the surface-water system.

6.0 REFERENCES

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USEPA, 1991. *Guidance for Water Quality–based Decisions: The TMDL Process.* U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

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